Remarks

As identified in the opening paragraph [0001] of the present application and in the transmittal documents that accompanied the application at the time of filing, the present application is a continuation-in-part of U.S. Serial No. 09/632,681 filed August 7, 2000. Additionally, Applicants hereby inform the Examiner that U.S. Serial No. 10/046,071 filed January 11, 2002 ("the '071 application") is also a continuation-in-part of U.S. Serial No. 09/632,681, and U.S. Serial No. 10/138,959 filed May 3, 2002 ("the '959 application") is a continuation of the '071 application. Applicants wish to notify the Examiner that the '959 and '071 applications remain pending to obviate any potential double patenting rejection. Additionally, copies of the references cited in the '959 and '071 applications (and not previously cited in the present case) are provided herewith in the enclosed Supplemental Information Disclosure Statement.

By the present amendment and response, Applicants have amended claims 56, 58-61, 63, 74-76, 79, 81, 82, 84, and 85, and cancelled claims 57 and 64-73. Claims 47-55 were previously indicated as being allowable by Examiner Drodge. Claim 56 has been amended to incorporate the limitations of previous claim 57, and claim 74 has been amended to incorporate the limitations of previous claim 75. The various other claim amendments have been made to promote clarity and correct minor errors. No new matter has been added.

Remarks addressing the Examiner's 35 U.S.C. § 102(e) rejections and objections as contained in the Office Action mailed October 7, 2003 are provided below.

Affirmation of Election of Group II

In a telephone conversation with the Examiner on September 25, 2003, Applicants made a provisional election without traverse to prosecute the invention of Group II, including claims 47-85. Claims 1-46 and 86-87 were withdrawn from further consideration by the Examiner as being drawn to a non-elected invention. Applicants hereby affirm the election without traverse of Group II in response to the Examiner's request at page 3 of the Official Action mailed on October 7, 2003.

Pending Claims

Claims 47-56, 58-63, and 74-85 are pending in the present application with claims 47, 56, and 74 being independent claims.

Allowed Subject Matter

Original claims 47-55 were deemed to be allowable by Examiner Drodge in the Office Action mailed on October 7, 2003.

Rejections

Claims 56-85 were rejected under 35 U.S.C. § 102(e) as being allegedly anticipated by U.S. 6,623,860 (Hu et al.). Since claims 57 and 64-73 have been cancelled, the rejections pertaining to those claims are considered to be moot. With regard to claims 56, 58-63, and 74-85 – all of which have been amended either directly or indirectly by amendment of a parent claim – Applicant respectfully traverses, since the Office Action does not establish how Hu et al. teaches the devices of the amended claims. Applicant submits that the amended claims 56, 58-63, and 74-85 are patentable over Hu et al.

A. Disclosure of U.S. 6,623,860 (Hu et al.)

U.S. 6,623,860 (hereinafter "Hu") is directed to multilevel microfluidic structures including first and second laminae each defining channel microstructures therein and communicating across a lamina interface wherein a region of a first-lamina microstructure overlaps a region of a second-lamina microstructure (Hu, col. 2, lines 14-34; col. 3, line 66 – col. 4, line 2; col. 18, lines 23-47). An interleaved (i.e., third) lamina or film may be disposed between the first and second laminae and define vias that permit flow between the microstructures defined in the first and second laminae (Hu, col. 4, lines 2-4; col. 7, lines 56-64; col. 9, lines 7-10). The laminae, which may be formed of various materials such as glass, plastic, or silicon, are bonded together following the formation of microstructures therein (Hu, col. 8, lines 13-50; col. 9, lines 11-17; col. 9, lines 57-62).

Microstructures that may be defined in laminae primarily include channels, vias, and reservoirs (Hu, col. 4, lines 4-6; col. 7, lines 26-27). Channels are "defined within a single level" (Hu, col. 7, lines 27-29) to lie within a plane of a substrate (Hu, col. 4, lines 4-10; col. 5, lines 26-43;). Vias permit fluid flow between channels or reservoirs where a region of a first lamina microstructure overlaps a second lamina microstructure (Hu, col. 2, lines 24-34; col. 4, lines 4-10; col. 5, lines 15-16; col. 7, lines 56-64; col. 9, lines 5-10; col. 10, lines 56-69) and may be substantially larger than a channel (e.g., channel widths of 50 micrometers compared to via diameter of 0.5 millimeter, col. 16, lines 45-50; *cf.* Figs. 2A-2C and Figs. 4A-4C) such as to permit one via to feed into a plurality of channels or reservoirs (Hu, col. 7, lines 58-64). Reservoirs may be defined in a lamina, extend through multiple lamina, or be defined in non-adjacent lamina and connected by vias (Hu, col. 4, lines 4-10; col. 7, lines 29-33). All vias and reservoirs are illustrated and described as being circular in shape (Hu, Figs. 1A-1C, Figs. 2A-2D, Fig. 3, Figs. 4A-4D, Fig. 5, Figs. 6A-6E, Figs. 7A-7D; col. 8, lines

1-6; col. 10, lines 9-11; col. 13, lines 27-33; col. 15, lines 19-21; col. 15, lines 64-65; col. 16, lines 48-50; col. 16, lines 59-60).

Channel microstructures may be formed in surfaces of laminae or substrates by molding, etching, embossing (Hu, col. 7, lines 27-29; col. 8, line 64 – col. 9, line 10), while reservoirs, vias, and (presumably) ports may be introduced by drilling through substrates (Hu, col. 10, lines 10-12). Channels are distinct from other structures such as vias and reservoirs (Hu, col. 4, lines 4-10; col. 6, lines 42-44; col. 7, lines 26-41; col. 7, lines 56-63; col. 10, lines 10-12; col. 12, lines 10-15; col. 13, lines 32-34; col. 15, lines 17-21; col. 15, lines 64-67; col. 16, lines 59-63). Fluidic inlet and outlet ports may be defined through external laminae, and either reservoirs or inlet ports may be used to provide fluidic access to the device (Hu, col. 4, line 64 – col. 5, line 11; col. 10, lines 13-17).

Electrodes may be provided to promote voltage-driven (electrokinetic) fluid movement in the devices (Hu, col. 7, lines 23-25; col. 8, lines 51-56; col. 11, lines 37-41; col. 16, lines 27-33). Voltage-driven mixing is used, wherein the degree of mixing between fluids is determined by the relative mobility of the components and the relative voltage differences imposed on wells of the device (Hu, col. 15, lines 2-8).

B. Hu Fails To Teach All The Limitations of Pending Claims 56 & 58-63

1. Slit disposed lengthwise substantially parallel to a junction channel

All of the pending claims 56 and 58-63 require a slit disposed between and in fluid communication with a junction channel and an outlet channel, the slit having a length substantially greater than its width and being "disposed lengthwise in a direction substantially parallel to the junction channel". To help visualize these elements, Applicants point the Examiner to one embodiment of such a mixing device provided in Figs. 14A-14B of the present application, with a slit 428 disposed substantially parallel to a junction

channel 424. As described in the original description at page 20, lines 6-19, such a mixer receives multiple fluids that flow side-by-side in the junction channel. The stream of two fluids flows through the slit and is "folded" into the outlet channel such that one fluid is layered substantially on top of the other fluid, thus providing a larger interfacial contact area that facilitates rapid diffusional mixing just downstream of the slit. A schematic of the fluidic interaction of such a mixing embodiment is illustrated in Fig. 14C of the present application.

Nothing in Hu teaches or suggests the use of a slit disposed between a junction channel and an outlet channel and having a length substantially greater than its width. Notably, despite the Examiner's argument that Hu discloses "slits or apertures between channels" (Office Action, page 5, fourth paragraph, *citing* Hu, column 9, lines 1-10), the word "slit" is totally absent from the Hu reference. The only similar structures permitting fluid communication between non-adjacent channels in Hu are described therein as vias (e.g., Hu, col. 2, lines 24-34; col. 4, lines 4-10; col. 5, lines 15-16; col. 7, lines 56-64; col. 9, lines 5-10; col. 10, lines 56-69); contrast *vias* with the formation of *channels*, which cannot directly communicate fluids to two other channels because each channel is formed only in the *surface* of a lamina (Hu, col. 7, lines 27-29; col. 8, line 64 – col. 9, line 10). Returning to the subject of vias, however, throughout the Hu reference vias are illustrated and described as being circular in shape. See, e.g., Hu, col. 10, lines 10-12 ("microstructures such as vias or reservoirs may be introduced by drilling"); Figs. 1A-1C (vias 112, 122, 126, 128 all illustrated as circular in shape); Figs. 2A-2D (vias 201, 203, 205, 212 all illustrated as circular in shape) and col. 13, line 33 ("the vias [are shown] as smaller circles"); Figs. 4A-4D (vias 410, 420, 426, 436 all illustrated as circular in shape) and col. 15, lines 64-65 ("the vias [are shown] as smaller circles"); Figs. 6A-6E (vias 612, 620, 622, 624 all illustrated as circular in shape) and col. 16, lines 59-61 ("the vias [are shown] as smaller circles"); Figs. 7A-7D (vias 712, 714 all illustrated as circular in shape). A circular via has only a single

major dimension (i.e., its diameter); consequently, the circular via lacks a "length being substantially greater than [its] width" as required of the slit of amended claim 56. Moreover, since a circular via lacks a discernable length, it cannot be "disposed lengthwise in a direction substantially parallel to [a] junction channel" as further required by amended claim 56.

2. Slit width substantially smaller than junction and outlet channel widths

All of the pending claims 56 and 58-63 also require that the slit have a width that is substantially smaller than the junction channel width" and "substantially smaller than the outlet channel width". Not only does Hu fail to disclose a "slit" within the meaning of claim 56, but also it fails to disclose any inter-layer fluid conduit structure that is smaller than its associated channels. Rather, throughout the Hu reference, vias disposed between channels are illustrated and described as being diametrically as large as or larger than the widths of their associated channels. See, e.g., Hu, col. 7, lines 58-64 ("one via may feed into a plurality of channels ... where the via would be substantially larger than a channel to accommodate the plurality of microstructures"); Figs. 1A-1C (vias 112, 122 illustrated as being as large as associated channels 110, 114, 120, 124); Figs. 2A-2D (vias 201, 203, 205, 212 all illustrated as larger than associated channels 206, 209, 210); Figs. 4A-4D (vias 420, 426, 436 all illustrated as larger than associated channels 418, 422, 424, 428, 434, 438); Figs. 6A-6E (vias 612 all illustrated as larger than associated channels 608, 630); col. 16, lines 45-50 (via diameter of 0.5 millimeter compared to channel width of 50 micrometers). Thus, not only does Hu not disclose any via configured as a slit, but also Hu fails to teach or suggest the use of via that are smaller than channels associated therewith.

C. Hu Fails To Teach All The Limitations of Pending Claims 74-85

1. Multiple apertures disposed between first and second channels

All of the pending claims 74-85 require the presence of a plurality of apertures defined in a common (e.g., third device) layer and "disposed between and in fluid communication with [a] first channel and [a] second channel". To help visualize these elements, Applicants point the Examiner to two embodiments of such a mixing device provided in Figs. 15A-15D and Figs. 16A-16B. In each embodiment, multiple apertures 458, 518 are disposed between two channels 450, 460, 515, 519. As described in the original description at pages 34-36, such mixers operate by flowing a first fluid through the multiple apertures to create multiple substreams that are injected into a flowing stream of second fluid to appear as "streaks," which provide a large interfacial contact area between fluids to promote mixing.

Despite the Examiner's suggestion to the contrary (Office Action at page 6, *citing* Hu, column 6, lines 60-67), nothing in Hu teaches or suggests the use of multiple apertures (e.g., vias) defined in a common layer and disposed between a first channel and a second channel. Similarly, nothing in Hu teaches suggests the "streak" mixing utility provided by a device according to claim 74. To the contrary, Hu teaches the use of voltage-driven mixing (e.g., Hu, col. 15, lines 2-8), in which the degree of mixing is determined by the mobility of the components and the applied voltage.

2. Multiple apertures each smaller than first and second channel widths

All of the pending claims 74-85 require that each aperture of the plurality of apertures disposed between the first channel and the second channel is substantially smaller in major dimension than each of the width of the first channel and the width of the second channel. As stated previously, nothing in Hu teaches any inter-layer fluid conduit

structure that is smaller than its associated channels. See, e.g., Hu, col. 7, lines 58-64 ("one via may feed into a plurality of channels ... where the via would be substantially larger than a channel to accommodate the plurality of microstructures"); Figs. 1A-1C (vias 112, 122 illustrated as being as large as associated channels 110, 114, 120, 124); Figs. 2A-2D (vias 201, 203, 205, 212 all illustrated as larger than associated channels 206, 209, 210); Figs. 4A-4D (vias 420, 426, 436 all illustrated as larger than associated channels 418, 422, 424, 428, 434, 438); Figs. 6A-6E (vias 612 all illustrated as larger than associated channels 608, 630); col. 16, lines 45-50 (via diameter of 0.5 millimeter compared to channel width of 50 micrometers). Thus, not only does Hu fail to teach the use of multiple apertures disposed between two channels, but also Hu fails to teach multiple apertures each having a diameter substantially smaller than each of a first channel width and a second channel width.

Based on the foregoing, Applicants submit that amended claims 56, 58-63, and 74-85 are novel over Hu, and therefore request of the outstanding rejections under 35 U.S.C. § 102(e).

Conclusion

By virtue of the amendment and arguments stated herein, Applicants believe that amended claims 56, 58-63, and 74-85 are in good condition for allowance, and respectfully request allowance thereof. If, for some reason, a notice of allowance cannot be envisaged after consideration of the present Amendment, a telephone call with the undersigned at (626) 351-8200 ext. 6503 to discuss any deficiencies would be earnestly appreciated.

Applicants also request consideration of the enclosed Supplemental Information Disclosure Statement and the references cited therein.

Respectfully submitted,

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